

# **Plans for Terra Longwave ADM Development**

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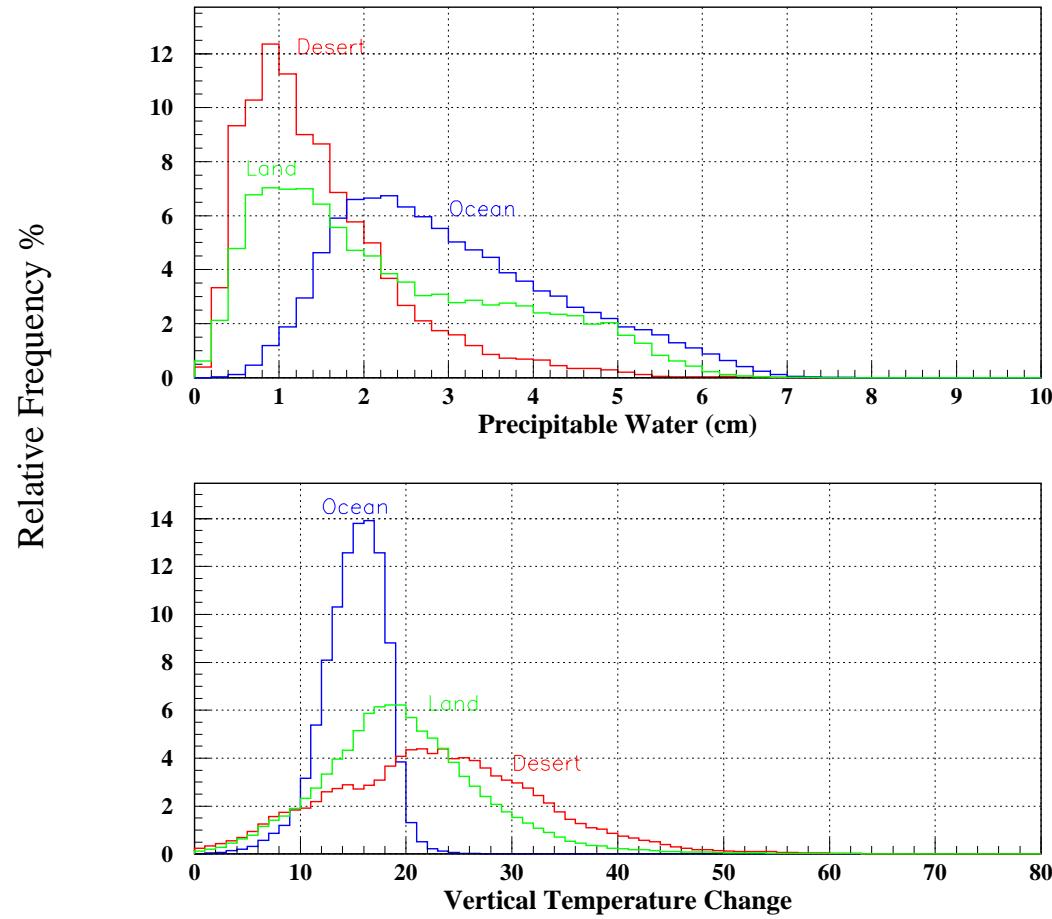
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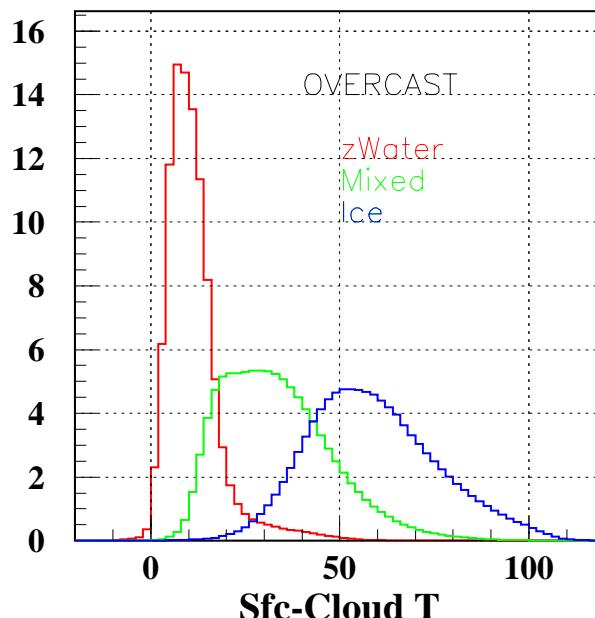
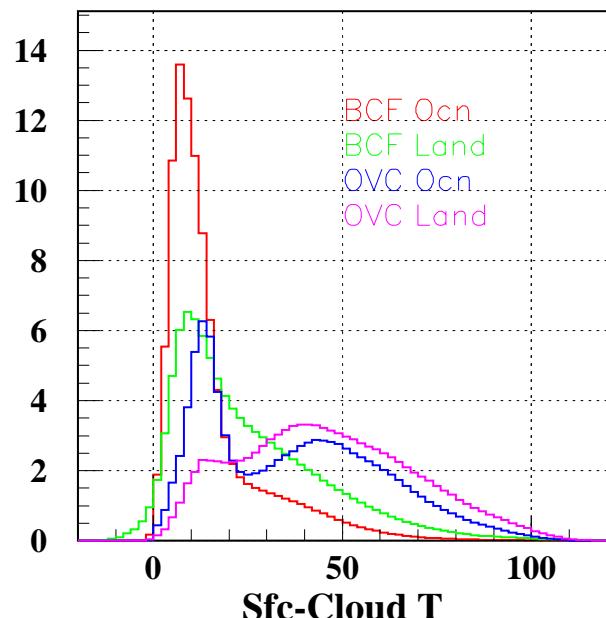
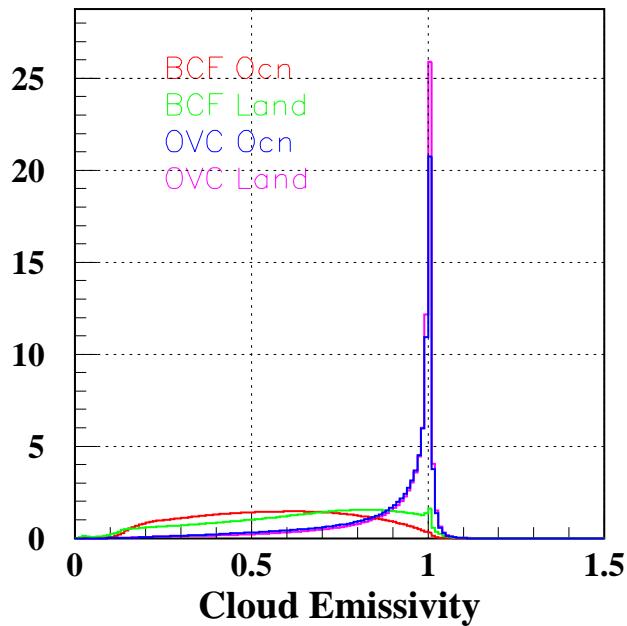
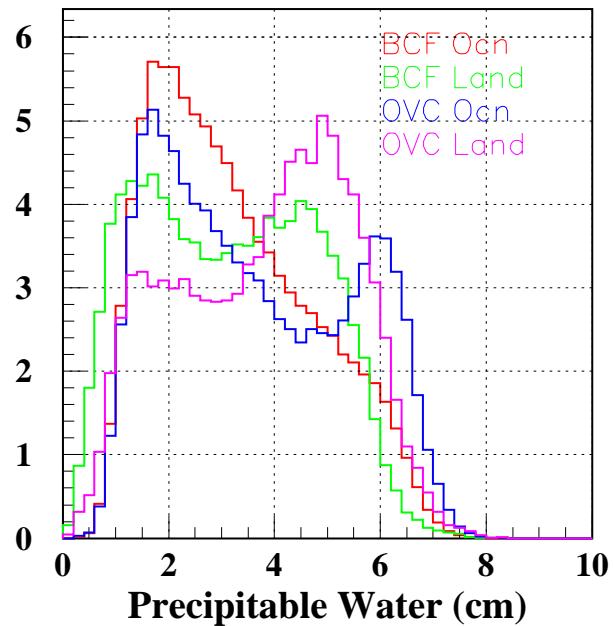
# OVERVIEW

- **Review of TRMM ADMs**
  - Selection of scene type parameters
  - Method of generating TRMM ADMs
  - Summary of results
- **Terra ADM Development Issues**
  - Scene type parameters (TRMM ADM parameters +?)
  - “?” Parameters: Relative azimuth angle, geotype, topography, skin temperature, etc.
  - Selection of a theoretical model for estimating radiances at unfilled VZA bins; minimizing/estimating Direct Integration errors (optimizing VZA bin width, extrapolation and integration techniques, etc.)

## ADM Clear Scene Type Parameters (Day)



ADM Cloudy Sky Scene Type Parameters (Day)



# SCENE TYPES FOR CERES-TRMM LW/WN ADMs

ADM Category	Scene Type Stratification	Total
CLEAR	Ocean	3 Precipitable Water
		5 Vertical Temperature Change
	Land	3 Precipitable Water
		5 Vertical Temperature Change
	Desert	3 Precipitable Water
		5 Vertical Temperature Change
BROKEN CLOUD FIELD (4 cloud intervals)	Ocean/Land/ Desert	3 Precipitable Water
		6 T(surface-cloud)
		4 IR Emissivity
OVERCAST	Ocean + Land	3 Precipitable Water
		7 T(surface-cloud)
		6 IR Emissivity

## METHOD

- Composite radiance measurements into: view zenith angle ranges, surface, cloud cover, and percentile intervals of meteorological/cloud properties.
- Compute mean radiance for each vza/scene type parameters combination. Apply theoretical model to extrapolate radiances in unobserved bins.
- Estimate radiant flux  $\widehat{M}$  using the Gauss quadrature integration from mean radiance measurements  $\bar{L}$  over the range of viewing zenith angle  $\theta$ :

$$\widehat{M} = 2\pi \int_0^{\frac{\pi}{2}} \sin \theta \cos \theta \bar{L}(\theta) d\theta$$

- Compute angular distribution model  $R$  for scene type  $j$  from

$$R_j(\theta) = \frac{\pi \bar{L}(\theta)}{\widehat{M}}$$

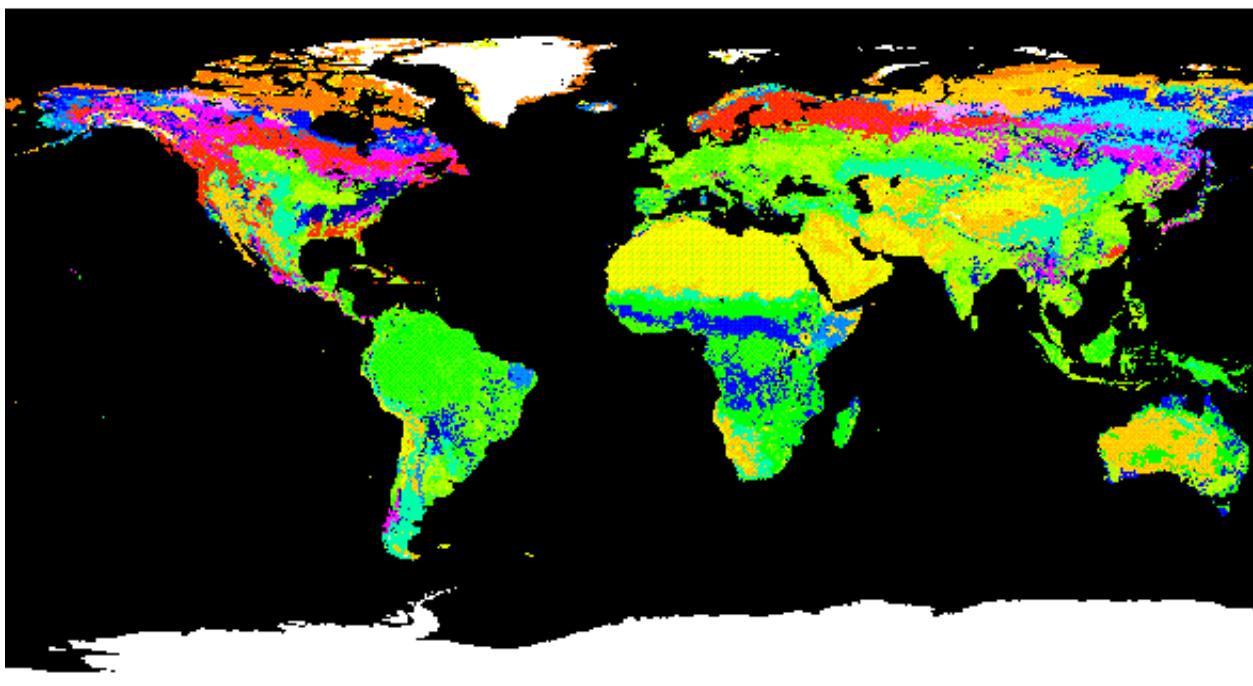
## **SUMMARY OF RESULTS (CERES/TRMM ADMs)**

- Clear sky ADMs are most sensitive to atmospheric lapse rate.
- Overcast and broken cloud field ADMs are most sensitive to cloud emissivity.
- WN ADMs exhibit similar dependence on scene type parameters as the LW ADMs but are generally more anisotropic.
- Empirical ADM-derived fluxes show less dependence on viewing geometry than ERBE-like fluxes.
- Validation results indicate that LW fluxes from CERES/TRMM ADMs show a factor of 2-reduction in error compared to ERBE.

# **Terra Spacecraft/CERES Instrumentation**

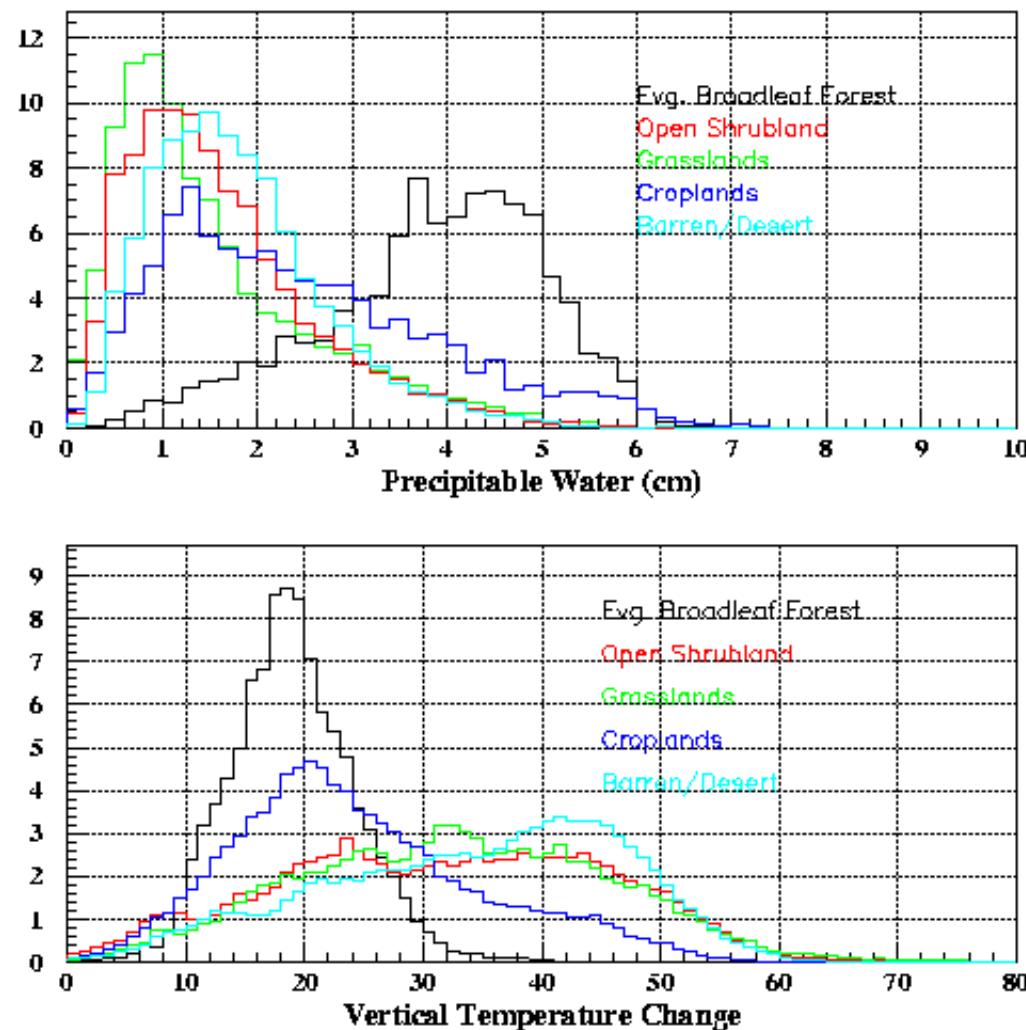
- **Orbit**
  - near-circular, polar orbit (global coverage)
  - altitude: 705 km (at equator)
  - inclination: 98.2 degrees
  - descending node: 10:30 a.m.
  - ground track repeat: 16 days
- **Instrumentation (Partial List)**
  - 2 CERES Scanners --> 1 crosstrack and 1 RAPS
  - MODIS

## International Geosphere/Biosphere Programme (IGBP) Scene Types (+ Tundra)



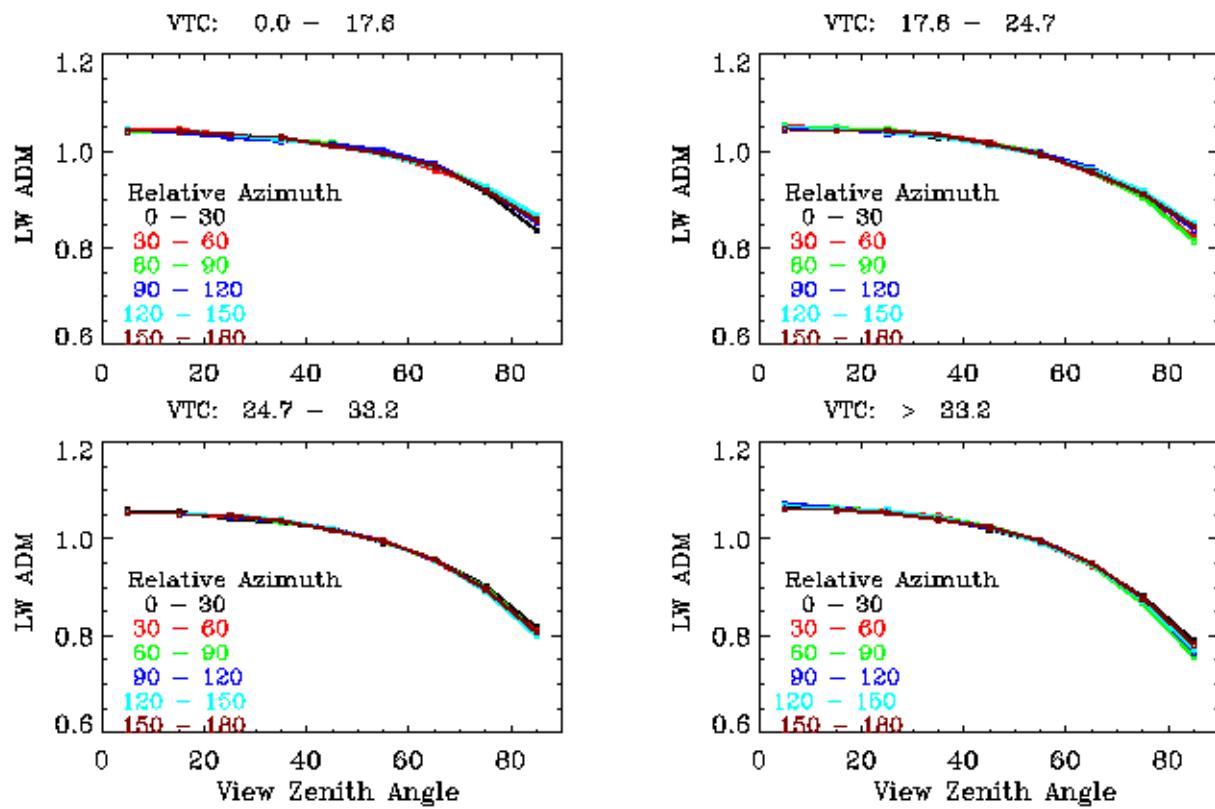
Evergreen Needleleaf Forest	Evergreen Broadleaf Forest	Deciduous Needleleaf Forest	Deciduous Broadleaf Forest	Mixed Forest	Closed Shrubland
Open Shrublands	Woody Savannas	Savannas	Grasslands	Permanent Wetlands	Cropland
Urban	Cropland/Natural Vegetation Mosaic	Snow and Ice	Barren/Desert	Water Bodies	Tundra

## RELATIVE FREQUENCY OF PW & VERTICAL TEMPERATURE CHANGE FOR IGBP SCENES



VARIATION OF CLEAR SKY LAND LW ADM  
WITH PW, VERTICAL TEMPERATURE CHANGE & RELATIVE AZIM

Precipitable Water: 1.44 – 2.75



## ADM Index

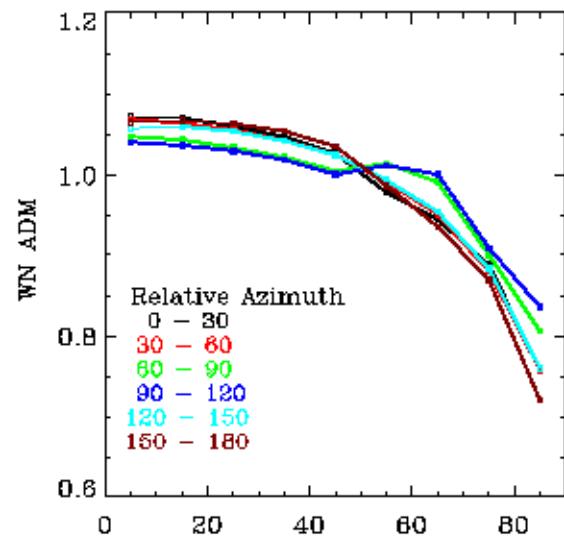
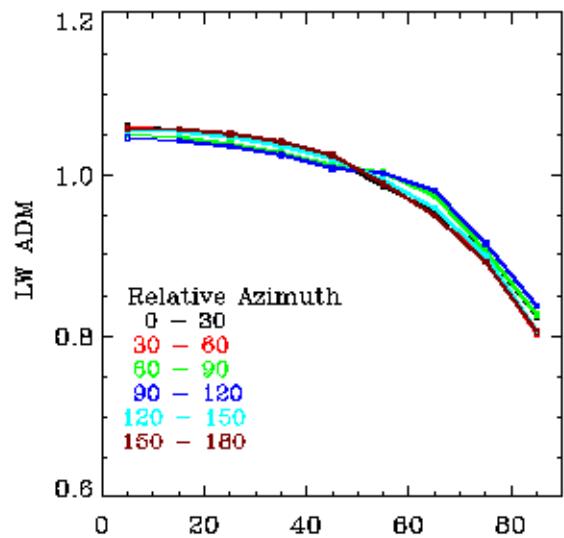
$$AI = \sqrt{\frac{\sum_{i=1}^n (R_{ji} - R_{Lamb})^2}{n}}$$

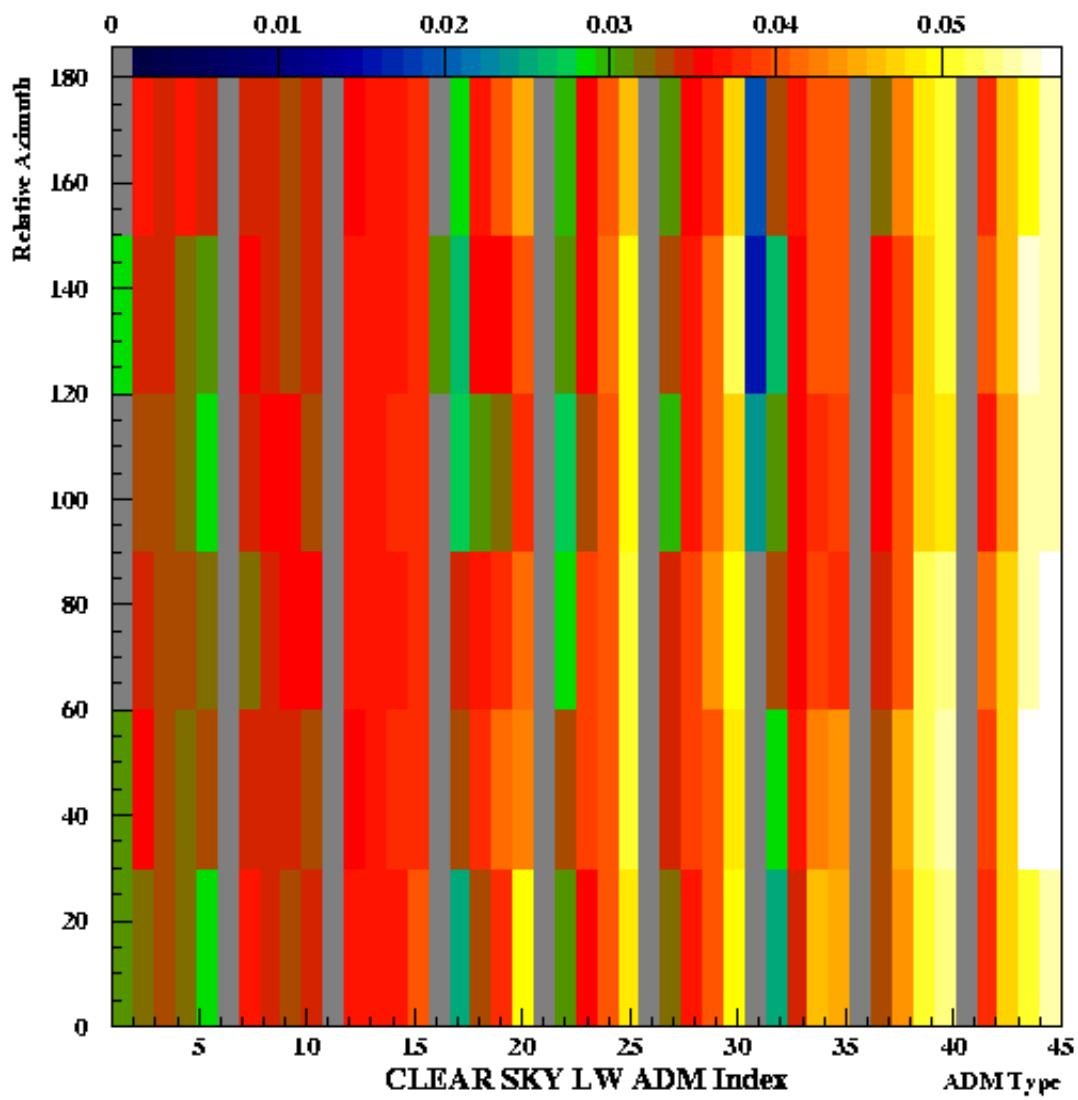
*n*: number of view zenith angle bins

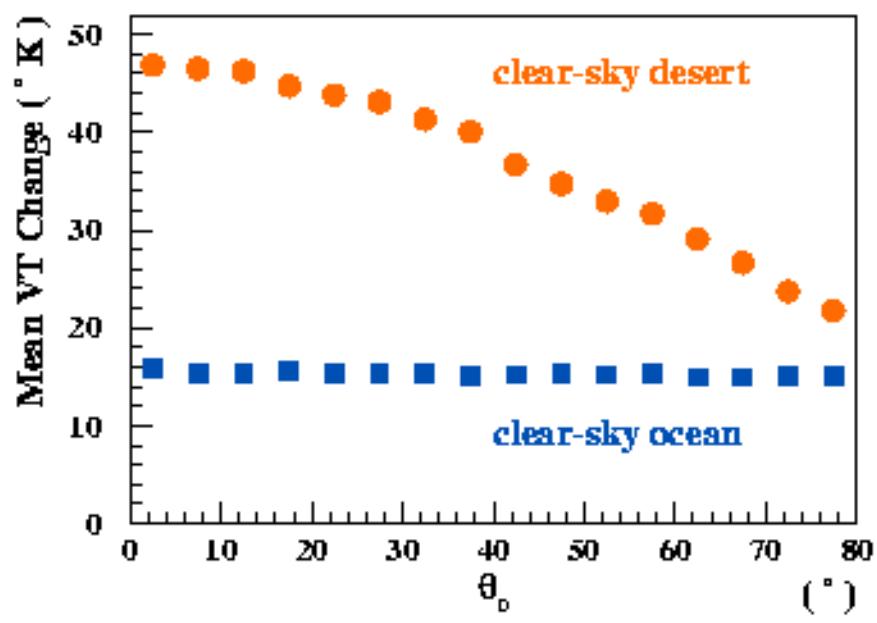
*j*: scene type

*Lamb*: Lambertian case

VARIATION OF CLEAR SKY LAND LW/WN ADM  
WITH RELATIVE AZIMUTH







LW/WN ADM Index vs. Relative Azimuth for Clear Land

